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THE NASA SPACE STATION PROGRAM PLANS

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INTRODUCTION

The United States now has underway a program to develop a permanently manned Space Station. The program was mandated by President Reagan and recently received a vote of confidence in the American legislature when Congress approved initial funding of $155 million to initiate technology development and preliminary design.

The National Aeronautics and Space Administration (NASA) is responsible for implementing the Space Station program. With the Space Shuttle development program now winding down, NASA is preparing for this new engineering and managerial challenge. The Johnson Space Center in Houston, Texas, has been designated as the "lead center" for the program. And at NASA Headquarters in Washington, DC, a new office has been established to direct the Space Station program. This new office, the Office of Space Station, is headed by NASA Associate Administrator Philip E. Culbertson.

Figure 1 conceptually portrays the architecture of a permanently manned Space Station. The concept includes both manned and unmanned elements and also includes the Space Shuttle as an integral element. Unmanned platforms, one of which is expected to be in a polar orbit, and servicing capabilities are key features of the concept. They will be important drivers of the final design.

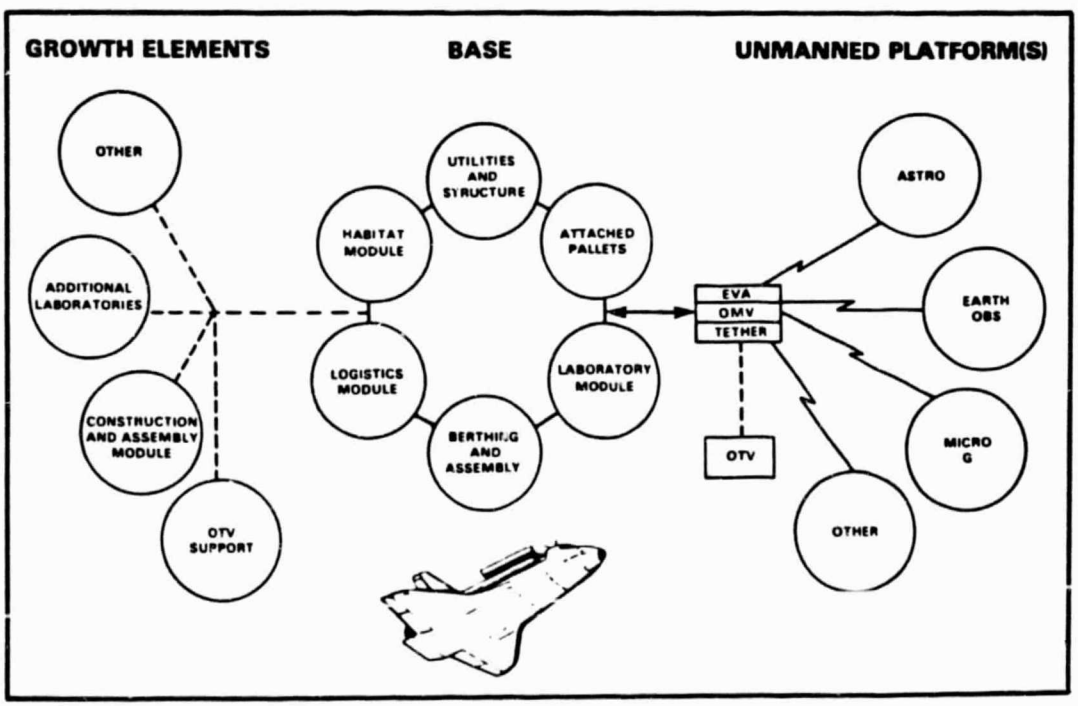

Figure 1. Space Station Program Architecture

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What this architecture might look like in a Space Station configuration is shown in Figure 2. Equally important is the built-in ability of the initial Space Station to evolve over time into a more capable system. Growth elements are part and parcel of the Space Station architecture.

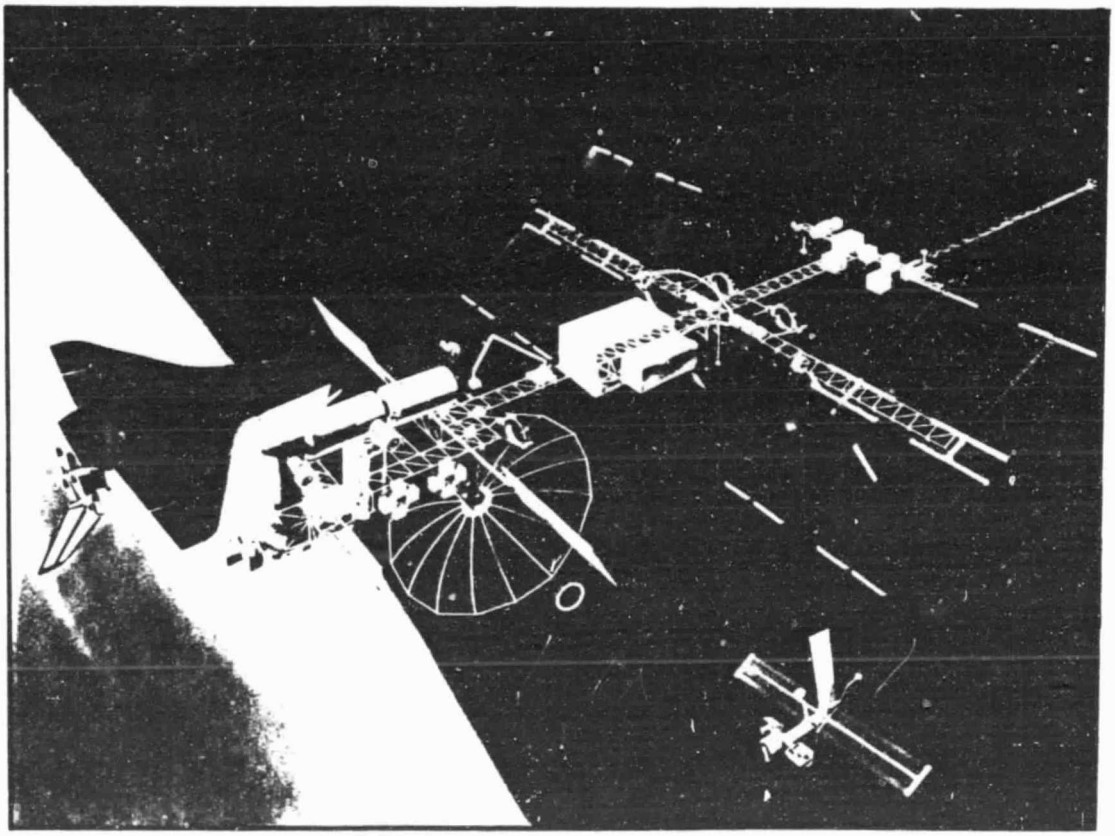

Figure 2.

BACKGROUND

Each year in January, the President of the United States gives a major address to the Congress called the "State of the Union" Address and, for both the Executive and Legislative branches of government, it is a major event. This year President Reagan's State of the Union message marked a recommitment to space on the part of the United States. The President stated:

> "We can follow our dreams to distant stars, living and working in space for peaceful, economic, and scientific gain. Tonight, I am directing NASA to develop a permanently manned Space Station and to do it within a decade."

The response in Congress to the President's initiative was positive and supportive. Both the House of Representatives and the Senate carefully reviewed the Space Station Program. In providing the initial funding, Congress has endorsed the idea of a Space Station as the next logical step in space for the United States. As importantly, this legislative action continues the bipartisan partnership between the President and Congress that has characterized the American space program from its inception.

SPACE STATION PLANNING GUIDELINES

Space Station planning in the United States has followed a set of guidelines that have included a set of major management and engineering criteria. These guidelines are shown in Table 1.

MANAGEMENT RELATED	ENGINEERING RELATED
• Three year extensive definition (5-10% of program cost)	• Continuously habitable
• NASA-wide participation	• Shuttle dependent
• Development funding in FY 1987	• Manned and unmanned elements
• IOC: early 1990's	• Evolutionary
• Cost of initial capability: $8.0B	• Maintainable/restorable
• Extensive user involvement – Science and applications – Technology – Commercial	• Operationally semi-autonomous • Customer friendly • Technology transparent
• International participation	

Table 1. Space Station Planning Guidelines

The U.S. Space Station program plans to have an initial operational capability (IOC) in the early 1990's. As proposed, the program envisions a U.S. investment of some $8.0 billion to achieve this capability. This estimate does not include operational costs nor the costs of scientific or commercial payload development. An in-depth, extended definition period will precede the development phase and the utilization emphasis that marked the preliminary NASA Space Station study activities will continue through both definition and design.

Noteworthy among the engineering-related guidelines is the requirement for the Space Station to be operationally semi-autonomous from the ground. For a facility that will be permanently manned and in operation 365 days a year, the type of extensive, tightly controlled ground direction used in the past is prohibitedly expensive and probably not warranted, given likely advances in technology and increased emphasis on human productivity.

Perhaps the most significant engineering criteria is that the Space Station be designed and built so that it will be evolutionary in all aspects including size, capability and technology. Figures 3-5 present drawings highlighting this evolutionary dimension. Of course, the drawings are illustrative only. Decisions on Space Station elements will be developed during the definition studies that will be initiated next year. These illustrations incorporate another key planning guideline, the prospect for international cooperation in the U.S. Space Station Program. This guideline is discussed separately below.

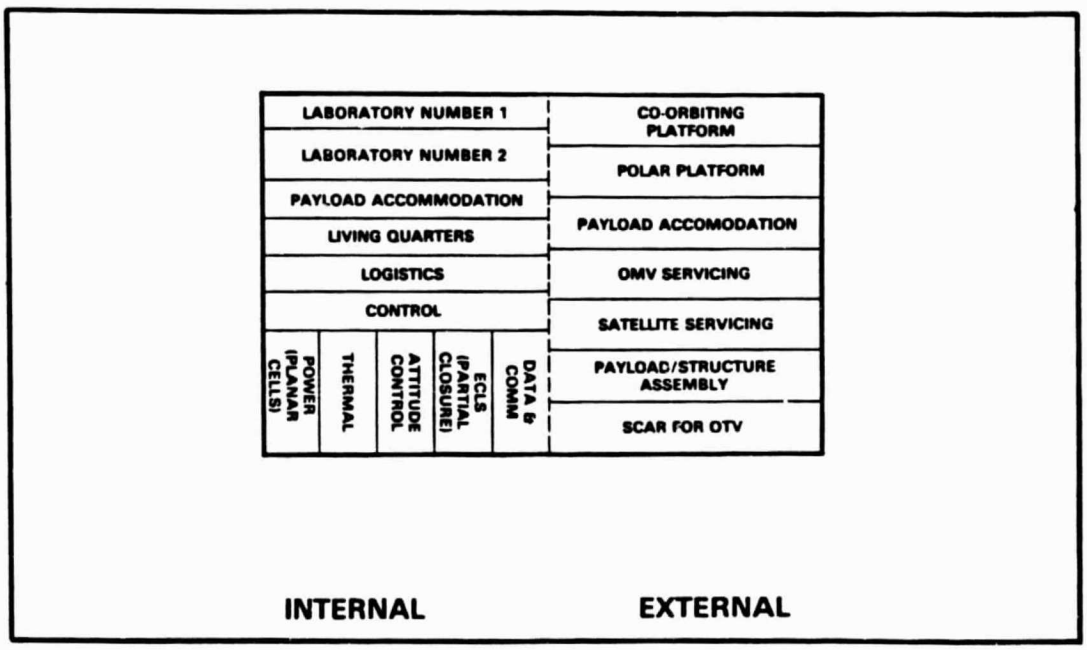

Figure 3. Scope of Initial Space Station

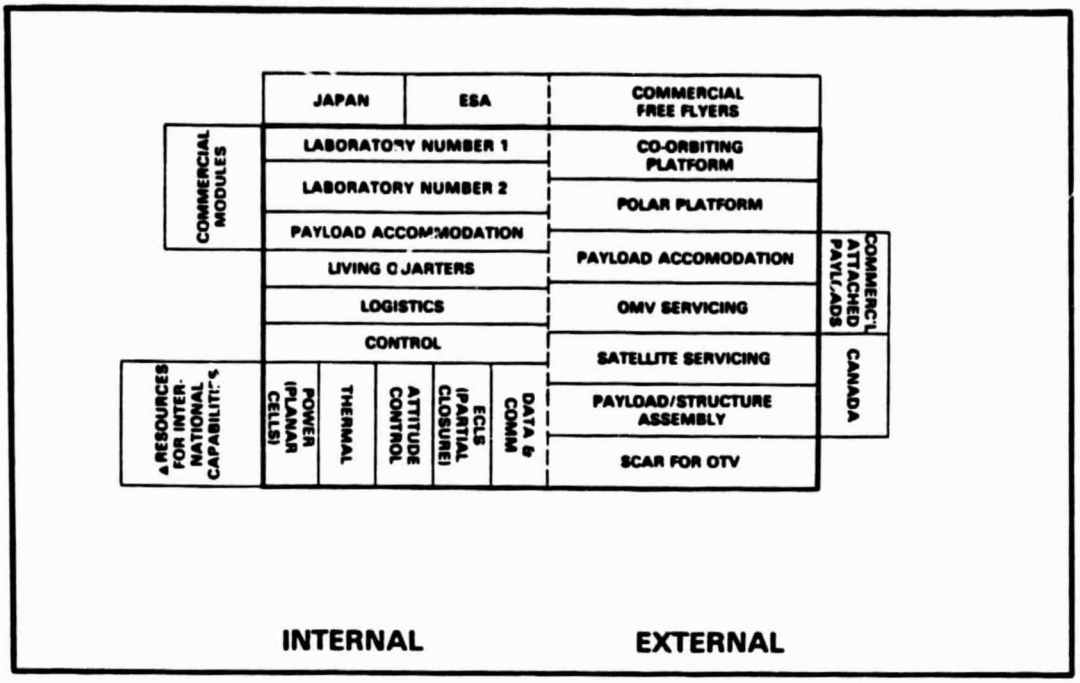

Figure 4. Added Scope for International and Commercial Participation

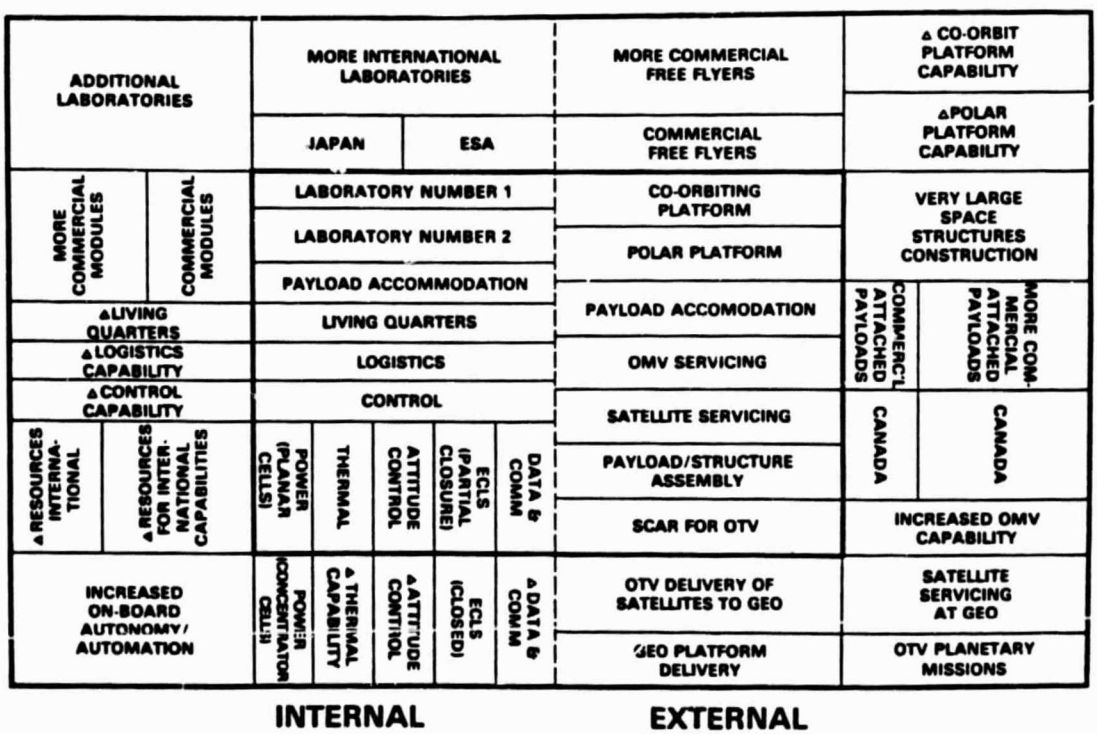

Figure 5. Growth Configuration

As shown in Table 2, the U.S. Space Station will be a multi-functional facility that will serve diverse needs. Not all of the capabilities required to satisfy these diverse needs will be incorporated in the initial operational capability. For example, the transportation function associated with the Space Station requires an Orbital Transfer Vehicle (OTV). This vehicle is currently under study. It is planned for use in the mid-1990's and will represent a significant addition to the IOC capabilities.

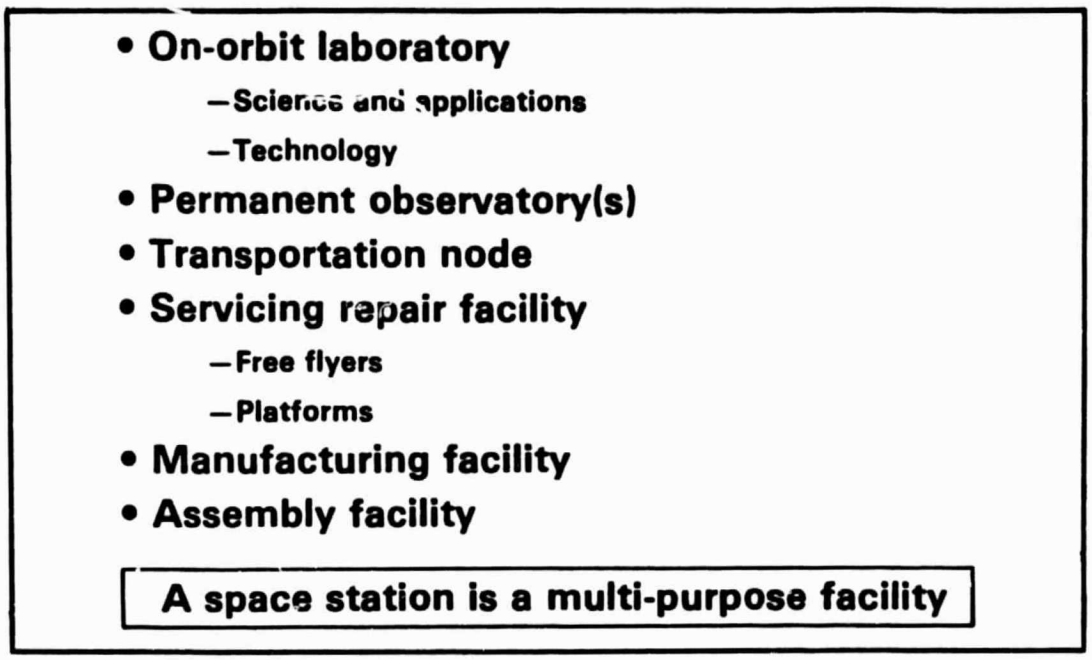

Table 2. Functions of a Space Station

POTENTIAL FOR INTERNATIONAL COOPERATION

President Reagan's State of the Union address contained an important message to U.S. allies and friends:

> "A Space Station will permit quantum leaps in our research in science, communications and in metals and life saving medicines which can be manufactured only in space. We want our friends to help us meet these challenges and share in the benefits. NASA will invite other countries to participate so we can strengthen peace, build prosperity and expand freedom for all who share our goals."

At the President's request, NASA Administrator James M. Beggs visited Europe, Canada, and Japan last spring to explain the President's offer and to review the Space Station activity NASA initiated

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in response to Mr. Reagan's directive. His impression was that interest in these countries is substantial, an impression confirmed by the efforts now underway there to specify what elements of a Space Station might be examined in definition studies to be undertaken separately but in coordination with NASA. The recent approval by the European Space Agency (ESA) Council to conduct such studies and to designate ESA as Europe's negotiator with NASA on the Space Station Program is seen in the United States as a significant step toward meaningful participation in the Program.

Perhaps even more significant are the Space Station discussions that took place at the recent London Economic Summit. President Reagan reviewed the program with Prime Minister Thatcher, Prime Minister Nakasone, and other leaders, as shown in Figure 6. The official communique of the Summit noted that the U.S. will report on the Program at next year's Economic Summit to be held in Bonn, Germany.

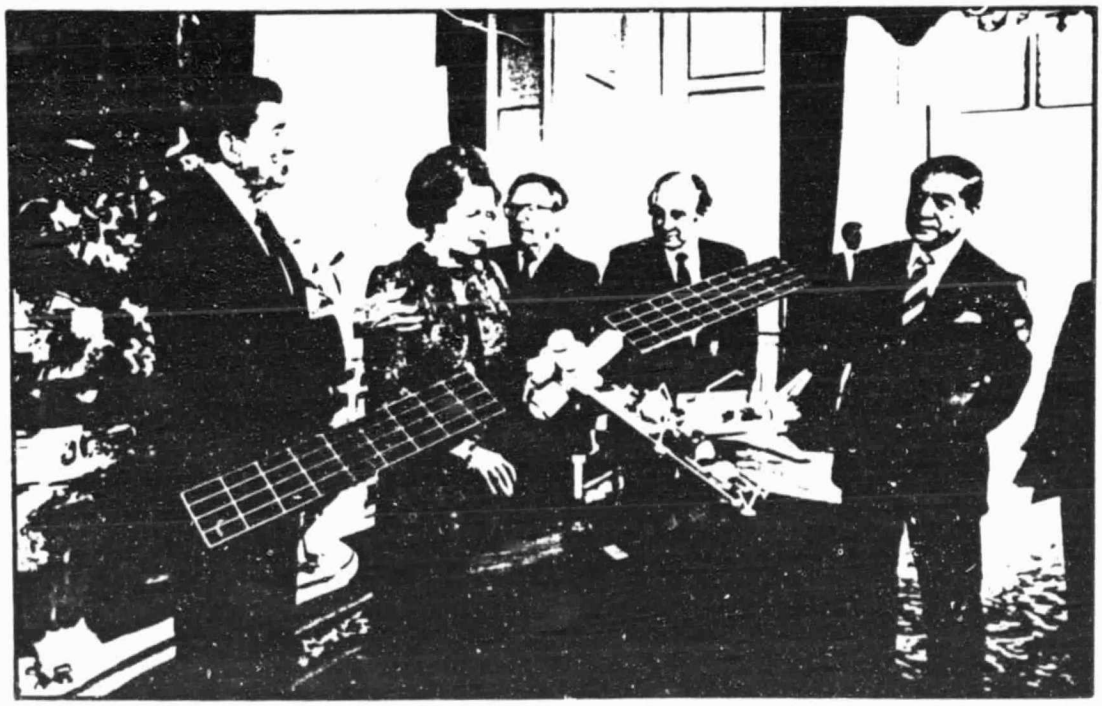

Figure 6.

The concept of international cooperation with NASA in peaceful space activities is not new. Such cooperation is a stated objective of the U.S. civil space program as set forth in the National Aeronautics and Space Act of 1958.

Over the past 25 years the United States has entered into over 1,000 agreements for cooperative activities with over 100 nations. These activities have been of mutual benefit to both the United States and the cooperative partners. Perhaps the most notable recent examples are the Spacelab, developed by the European Space Agency per the Space Shuttle Program, and the Shuttle's Remote Manipulator System, built by Canada and used so effectively earlier this year in the repair of the Solar Maximum Mission Spacecraft. A key example in future programs is the retropropulsion module now under construction by West Germany for the Galileo spacecraft which will be launched to Jupiter in 1986.

A number of primary criteria or guidelines have been followed in these programs. Government agreements are reached in which each partner accepts full technical and financial responsibility for their portion of the program. A minimal of technical information is exchanged, only that necessary to achieve an effective interface, and clear technical interfaces are preserved. A major consideration is utilization by the partner of the end product.

As depicted in Table 3, there are three primary modes of international participation in the United States Space Program. As a customer-oriented facility, the Space Station will be available to countries whether or not they participate in the development phase. And any nation with significant involvement in the development phase as a builder will have a role to play in the operation of the Space Station itself. However, NASA hopes that partners in the Space Station endeavor will be involved in all phases of the program: development, utilization, and operations.

Three Types of Potential Cooperation:

USER	**—Defines missions and utilizes station capabilities**
BUILDER	**— Participates in definition and development programs**
	— Contributes to station capabilities
OPERATOR	**—Support in operational phase**

Table 3. Space Station Program International Cooperation

COMMERCE IN SPACE

We in the United States believe that the private sector role in space will increase substantially in the future. A key dimension of President Reagan's national space policy is to foster such participation. The policy states in part:

> "The United States Government will provide a climate conducive to expanded private sector investment and involvement in space activities, with due regard to public safety and national security."

Space, of course, is already commercialized. In the United States and Europe, the communications industry is in large part space-based. In the United Kingdom, for example, industry has benefited from an early recognition that "comsats" could be a profitable undertaking. Launch vehicles and upper stages are presently subjects of commercial investment. Efforts to make remote sensing from satellites profitable are underway in France and the U.S. Materials processing is also a candidate for space-based commercial activities. Research in West Germany, Japan, and the United States point to a potentially large market for materials processed in space.

In response to a recent Presidential directive intended to accelerate participation of the private sector in space, NASA has begun to reexamine its own role in fostering the commercial utilization of space. New policies and accompanying organizational changes are expected shortly. The Agency realizes that the initial front end risks of space ventures must be reduced. It understands that the research data base supporting such ventures must be expanded. It also understands that respect for intellectual property and proprietary data are essential requirements for any commercial endeavor in space. And it knows that for space to realize its true commercial potential, practical-minded businessmen must be convinced that their company can profit by going into space.

In planning the Space Station, NASA is focusing upon making sure the Station is conducive to use by customers, one category of which is expected to be commercial enterprises.

The benefits to commercial customers of an operational Space Station in orbit and "open for business" are several. The Station itself, as a permanent facility, offers the kind of program stability and continuity private investors seek. Another benefit is the capability represented by the pressurized laboratory module(s) that will serve both science and commerce. Another is the repair and assembly capability the Space Station will have. Still another, and perhaps a critical one, is the presence of man, permanently and without the constraints of time now associated with space flight.

Further into the future as new technologies mature and as experience is gained with the Space Station's repair and assembly capabilities, commercial prospects look even brighter. Indeed it is not difficult to see a separate Space Station, owned by private business, devoted exclusively to commercial operations.

PLANNING SCHEDULE

Current Space Station planning schedules are shown in Figures 7 and 8. Important milestones include the negotiation of definition phase agreements targeted for completion by the end of this year between the U.S. and potential partners in the Space Station endeavor and the beginning of NASA's own definition studies in April, 1985.

CONCLUSION

The United States is now committed to developing a permanently manned Space Station within a decade. President Reagan has invited U.S. allies and friends to join in this endeavor. A Space Station will advance science, stimulate technology and support commerce. It also will foster the goal we share of using space peacefully and productively.

There is a challenge here for all of us. That challenge is to discern and then capture the enormous potential a Space Station offers. It is a challenge for us in the United States and it is a challenge for you here in Europe.

NASA is now hard at work planning the Space Station Program. In a wide range of endeavors, engineering, user requirements, and technology, work is proceeding at full speed. NASA intends to keep its potential international partners fully informed of this activity and hopes to involve them more deeply in future planning once formal agreements on definition studies are established. NASA's goal is to develop and operate a Space Station with significant international and commercial participation. The result can be a new capability in space that is of benefit to all.

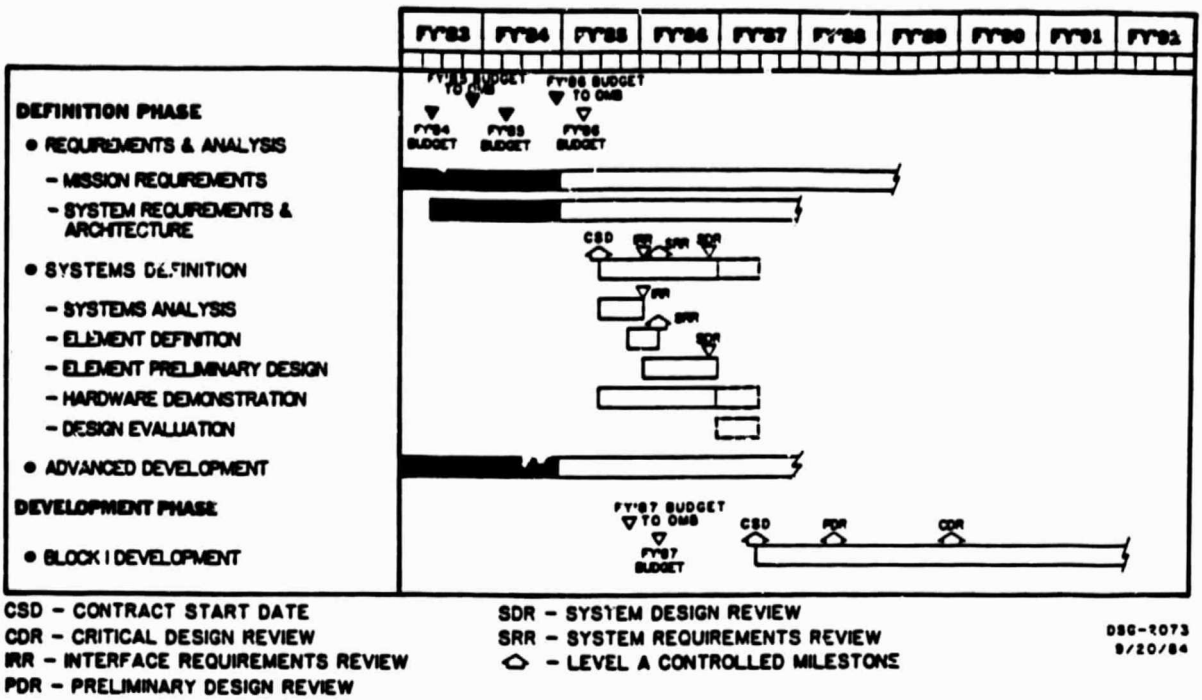

Figure 7. Space Station Program Schedule

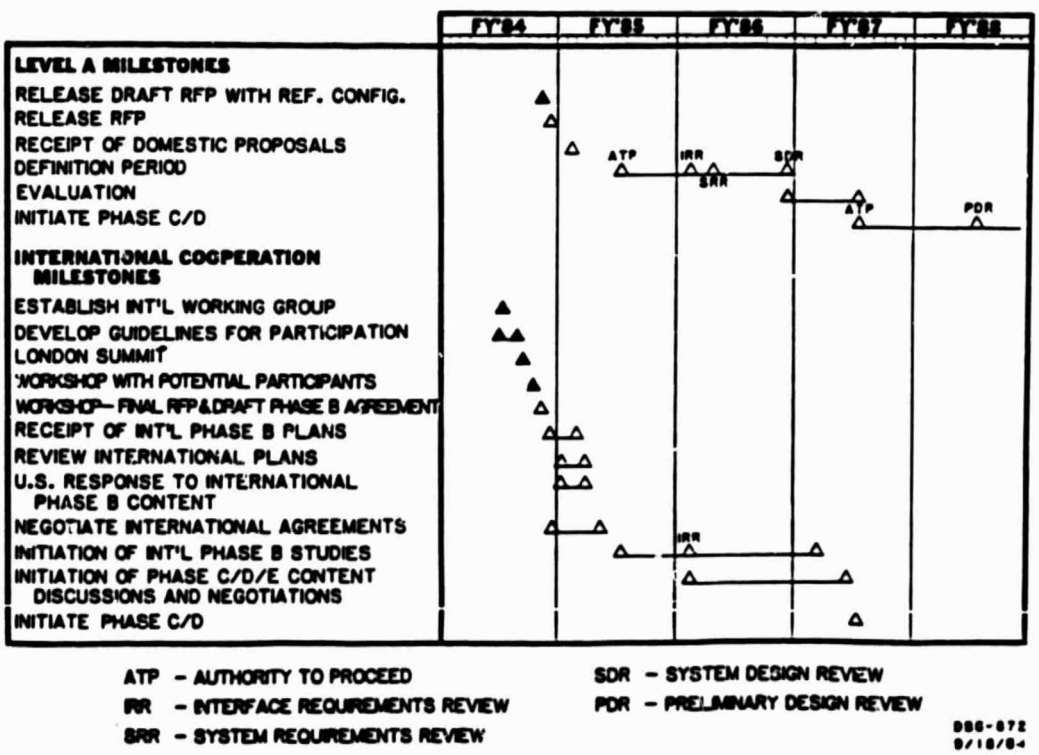

Figure 8. International Cooperation and Planning for Phase B Definition